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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C04B 41/50, G21F 9/30, 9/00, B44C 1/02 | A1

(11) International Publication Number: WO 95/35269

(43) International Publication Date: 28 December 1995 (28.12.95)

(21) International Application Number: PCT/GB95/01421

(22) International Filing Date: 16 June 1995 (16.06.95)

(30) Priority Data:
9412237.1 17 June 1994 (17.06.94) GB

(81) Designated States: CA, JP, KR, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

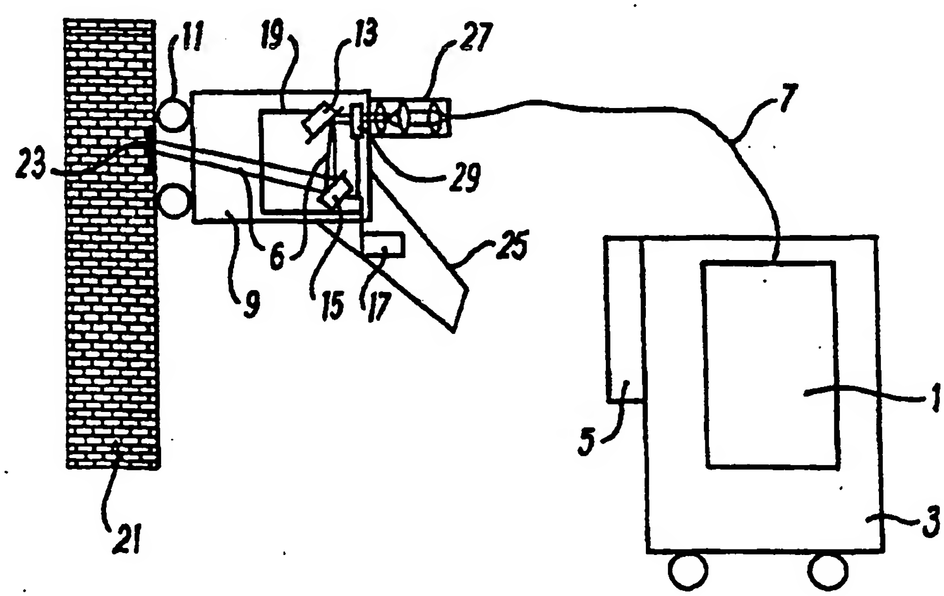
Published
With international search report.

(71) Applicant *(for all designated States except US)*: BRITISH NUCLEAR FUELS PLC [GB/GB]; Risley, Warrington, Cheshire WA3 6AS (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LI, Lin [CN/GB]; 5 Redmain Way, Croxteth, Liverpool L12 0LU (GB). SPENCER, Julian, Timothy [GB/GB]; British Nuclear Fuels plc, Springfields Works, Salwick, Preston PR4 0XJ (GB). STEEN, William, Maxwell [GB/GB]; Linkside, Links Hey Road, Cadley, Wirral L48 1BU (GB).

(74) Agent: MCCORMACK, Derek, James; Intellectual Property & Patents Dept., British Nuclear Fuels plc, Risley, Warrington, Cheshire WA3 6AS (GB).

(54) Title: GLAZING OF BRICKS



(57) Abstract

A method of glazing a brick surface which comprises applying an intense supply of heat to the surface by one or more laser beams and wherein the glazing is achieved by direct laser melting of a controlled layer of brick surface. Alternatively, glazing is achieved by application to the brick surface of a coating comprising specified colouring pigments and/or materials that can improve the glazing quality, followed by laser melting of the coating into a portion of the brick surface.

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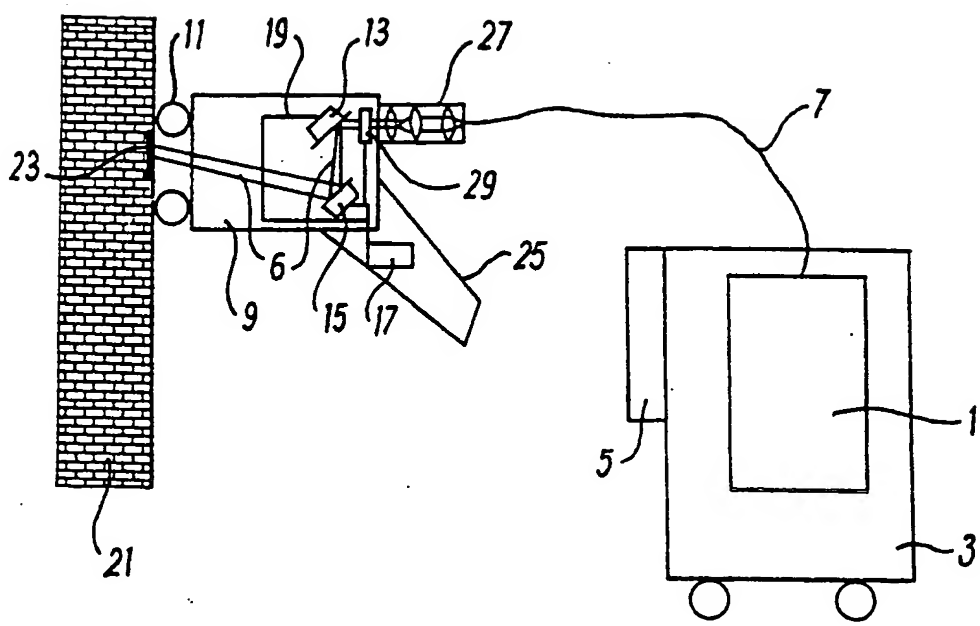

FIG. 1

GLAZING OF BRICKS

The present invention relates to glazing of bricks. Bricks are the oldest industrial material known to man. The use of bricks for construction can be dated back to 8000BC. Some brick structures which are over three thousand years old still maintain an attractive appearance. Generally bricks for buildings are classified into a) common bricks which does not require specific quality, b) facing bricks which are used for the decorative effects, and c) engineering bricks which have specific compressive strength and water absorption limits. These bricks are currently available manufactured from three types of materials sources as follows:

1) Clay brick: which is made of clays containing Al_2O_3, SiO_2, Fe_2O_3 etc. The manufacturing of this type of brick has the longest history. It involves preparation of mouldable clays, moulding, drying and firing. The firing of the clays causes the water to be driven out (below 150°C), chemical dehydration (starting at 400-600°C), oxidation of any organic materials (250°C - 700°C) and finally formation of ceramic bond between 800 - 1300°C. Since the materials are not molten, glazing does not take place at the manufacturing stage.

2) Sand-lime brick or flint lime brick. This type of brick is made of sand ($SiO2$), of crushed flint and hydrated lime, $Ca(OH)2$, compressed and hardened by treatment with steam under pressure in an autoclave. A similar firing process changes the hydraulic bonded materials into ceramic bonded brick. No melting takes place at this stage.

3) Concrete brick which consists of calcium, $SiO2$ and $Al2O3$ compounds. A similar process to the clay brick and sand-lime is required to produce ceramic bonded bricks. No melting takes place.

In all of these kinds of bricks, $SiO2$ exists as one of the principal constituents. Upon melting amorphous glassy

materials can be formed. These are normally obtained during manufacturing of face bricks or tiles by inserting the brick or tiles into a molten glass bath.

After the bricks are used in building construction, no further modification of the bricks by melting or glazing normally takes place.

There are cases when decoration of the brick surface in the building is required at a particular location after the building has been built. Complex patterns or fine lines or various colours may be required and these cannot be made easily by prefabrication using tiles or face bricks.

There are also cases when some areas of bricks of buildings are contaminated by high levels of radioactive, biological or chemical substances. Glazing of the surface can immobilise, fix and seal the contamination in the bricks to prevent mobility of the contamination.

The purpose of the present invention is to provide a method of glazing a brick surface after the brick has been used to form part of a building structure.

According to the present invention there is provided a method of glazing a brick surface which comprises applying an intense supply of heat to the surface by one or more laser beams.

The glazing is achieved by direct laser melting of a controlled layer of brick surface or by application of a coating with specified colouring pigments and/or materials that can improve the glazing quality, followed by laser melting of the coating into a portion of brick surface.

The laser glazing of brick can be used to produce a protective, impermeable coating for a specialised structure for use in a chemical and nuclear plant installation.

The laser glazing of brick can also be used to seal or immobilise the surface and embedded contaminations thereon such as of a radioactive, biological or chemical nature

onto the surface of bricks forming the building or structures.

The laser glazing of brick can be used to produce artistic patterns, signs, symbols or various colours on existing buildings.

Glassy patterns or symbols can be formed on bricks of the building structure by laser melting of a thin layer of surface of fusion coating material with desired colours or properties by one or more laser beams on the brick. Since bricks are ceramic bonded blocks they do not suffer a bond weakening by laser generated heat affected zone as happens for hydraulic bonded materials such as concrete. The high SiO2 content in the brick enables the formation of amorphous surface (glassy) after melting by laser beams.

A coating may be applied to the brick prior to the laser glazing. This coating may contain siliceous materials. The coating can be refractory cement, sand bonded with sodium silicate solution.

The laser treated brick surface depth may be between 0.1 to 2 mm. The bond between the glazed surface and substrate is a ceramic type which is not much weakened due to the laser heat effect. The result of the process is to generate an impermeable layer for the protection of underlying material, and to produce artistic patterns and to seal and remove contamination therewith.

A computer may be employed to generate a described pattern of a laser beam on a surface to provide a symbol, picture etc.

The said laser beam may be of ultraviolet, visible or infrared wavelength.

The laser beam may be generated by a laser generator such as a gas laser, eg a CO_2 gas laser or a CO gas laser, a solid state laser, eg a Nd-YAG (Neodymium-Yttrium-Aluminium-Garnet) or a Ti-Sapphire laser, an Excimer laser, a dye laser, a free electron laser or a semiconductor laser.

The laser beam may be either pulsed or continuous.

The laser beam may be applied from a laser source to the region of the surface to be treated via an operator handset or mobile application box adjacent to the wall which may be moved by a human or robotic operator to guide the beam to the required part of the surface to be treated. The beam may be delivered from the laser source to the handset by a flexible beam delivering system, eg one or more optical fibre guides or cables, or by optical mirrors which reflect the beam or by a hollow waveguide all in a known way. The handset may include a scanning means which sweeps the laser beam over the surface to be treated with a controlled sweep speed, pattern and rate.

The total laser power density of the laser beam or beams may be between 200 - 250 W/cm^2 depending on materials to be treated. Thus focusing of laser beam may or may not be needed depending on the raw beam diameter. The laser beam intensity may be from 150 W/cm^2 to 10 kW/cm^2. The beam scanning speed may be from 1 mm/sec to 200 mm/sec depending on the type of brick treated.

An embodiment of the present invention will now be described by way of example with reference to the accompanying drawing, in which

Figure 1 is a side view of an arrangement for glazing the surface of a brick wall.

As shown in Figure 1, a laser 1 carried on a trolley 3 is controlled by a control unit 5 on the trolley 3. An output beam 6 provided by the laser 1 is conveyed by a guide 7 to a transparent box 9 movable on a wall by wheels 11 and supported by a support (not shown). The box 9 incorporates an x scan mirror 13 and a y scan mirror 15 both of which are motor controlled by a control 17 which controls the attitudes of the mirrors 13, 15 and the operation of a shutter 29. The mirrors 13, 15 are contained in an inner transparent enclosure 19. The beam 6 is guided via lenses 27 and the shutter 29 by the

mirrors 13 and 15 onto the surface of a brick wall 21 forming a glazed area 23 in a required pattern etc. as required. The box 9 may be pushed by a handle 25 held by a human or robotic operator.

Collimation of the beam 6 is provided by the lens 27 to convert the diverging beam from the guide 7 into a parallel beam of desired diameter.

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Claims

1. A method of glazing a brick surface which comprises applying an intense supply of heat to the surface by one or more laser beams and wherein the glazing is achieved by direct laser melting of a controlled layer of brick surface.

2. A method as in Claim 1 and wherein the glazing is achieved by application to the brick surface of a coating comprising specified colouring pigments and/or materials that can improve the glazing quality, followed by laser melting of the coating into a portion of the brick surface.

3. A method as in Claim 2 and wherein the coating comprises siliceous materials including refractory cement, and sand bonded with sodium silicate solution.

4. A method as in any one of the preceding claims and wherein the method is used to produce a protective impermeable coating for a specialised structure for use in a chemical and nuclear plant installation.

5. A method as in any one of Claims 1 to 3 and wherein the method is used to seal or immobilise the surface and embedded contaminations thereon, including contaminations of a radioactive, biological or chemical nature, onto the surface of bricks forming buildings or structures.

6. A method as in any one of Claims 1 to 3 and wherein glassy patterns or symbols are formed on bricks of buildings or structures by laser melting of a thin layer of surface of coating material having desired colours or properties by one or more laser beams on the brick.

7. A method as in Claim 6 and wherein a computer is employed to generate a described pattern of the laser beam on the surface to provide a symbol, pattern, sign, picture or the like.

8. A method as in any one of the preceding claims and wherein the laser treated brick surface depth is between 0.1mm to 2mm.

9. A method as in any one of the preceding claims and wherein the laser beam is of ultraviolet, visible or infrared wavelength.

10. A method as in Claim 9 and wherein the laser beam is generated by a laser generator selected from a gas laser, a solid state laser, an excimer laser, a dye laser, a free electron laser or a semiconductor laser.

11. A method as in Claim 9 or Claim 10 and wherein the laser beam is either pulsed or continuous.

12. A method as in any one of Claims 9 to 11 and wherein the total laser power density of the laser beam or beams is between 200 W/cm^2 to 250 W/cm^2, the laser beam intensity is from 150 W/cm^2 to 10 kW/cm^2 and the beam scanning speed is from 1 mm/s to 200 mm/s.

13. A method as in any one of the preceding Claims and wherein the laser beam is applied from a laser source to the region of the brick surface to be treated via an operator handset or mobile application box adjacent to the surface, the handset or application box being moved by a human or robotic operator to guide the beam to the required part of the surface to be treated, the beam being delivered from the laser source to the handset by a flexible beam delivering system, the handset including a scanning means which sweeps the laser beam over the surface to be treated with a controlled sweep speed, pattern and rate.

14. A method as in Claim 13 and wherein the beam delivering system comprises one or more optical fibre guides or cables.

15. A method as in Claim 13 and wherein the beam delivering system comprises optical mirrors which reflect the beam.

16. A method as in Claim 13 and wherein the beam delivering system comprises a hollow waveguide.